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The various combinations of television equipment suitable for use in deaf education are described in terms of the systems used. The classroom system would consist of two cameras, a videotape recorder, a special effects generator for captioning, and a monitor of sufficient size for classroom viewing. The campus system would have the same capabilities but would be of broadcast quality, requiring a full time manager. The regional system would necessitate establishment of a regional captioning center as an interim project, to be manned by professional staff which would create needed program packages and engage in research and design of software. The national system would provide for electronic captioning for open circuit television. For all the above systems, technical aspects are considered, and operating equipment costs are estimated. Staff requirements are specified for campus and regional systems, and equipment layouts are provided for all but the national system. (JD)

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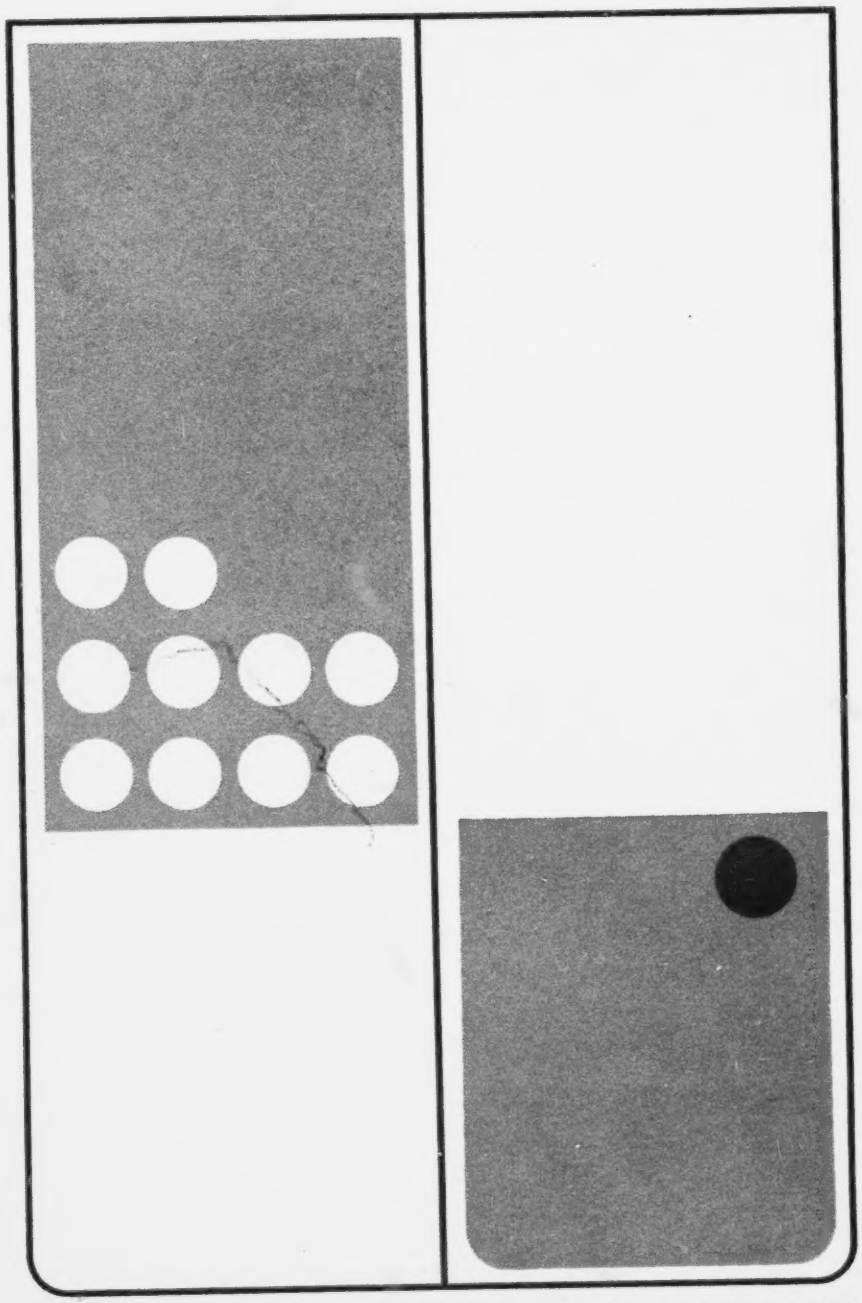
SUGGESTIONS & GUIDELINES FOR DEVELOPMENT OF TELEVISION FACILITIES IN SCHOOLS FOR THE DEAF



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SUGGESTIONS AND GUIDELINES FOR DEVELOPMENT OF TELEVISION FACILITIES IN SCHOOLS FOR THE DEAF

Prepared by:

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Knoxville, Tennessee

January 1968

FOREWORD

If there is any one thing that most educators of deaf people have learned in the past century and a half, it is that they must constantly search for better ways to help deaf children and adults to overcome the educability gap caused by early profound deafness. Long ago those with ample experience learned that there is no panacea -- no pat answer nor single method that will serve the needs of all.

In this second post-sputnick decade, education for the deaf has been given the benefit of all manner of research and practice in general education, psychology of learning, and in technology. With newer insights into learning, and the techniques for applying educational skills has come a variety of new media to assist the teacher in her attempts to reach the mind of the child. Congress and the Federal government have given tremendous assistance with the establishment and follow-up support given to Captioned Films for the Deaf. Visual and auditory media have been given much study. Equipment has also been made available to schools for the deaf for their use in the classroom.

One of the older "new" media which has to date not been given much application to the problems of educating deaf children and adults combines the use of both vision and hearing. It also offers immediate access to current events and those culturally enriching experiences which have not been readily available to the deaf. Television offers both vision and audition simultaneously. It also has the significant additional

factor of ready accessibility in the majority of homes.

When television is also made available to the classroom teacher and in the dormitories of residential schools, the prospects for its use as an audio-visual medium are almost limitless. This proposal for full use of television in the education of the deaf offers some very exciting possibilities for use with all, whether children or adults. As in other media, the instruments themselves are useless if the educational materials needed to use them are not developed by the teacher. By the same token, the teacher can provide individualized instruction and enrichment of experience through television in ways that could never be done by conventional teaching methods based upon the lecture approach.

Educators of the deaf, here is your opportunity to prove again in this century what our forefathers in the field did in the last. They used all manner of media available to them in their time, such as books, pictures, charts, chalk and chalkboard. Can we do any less in our time?

W. Lloyd Graunke
Superintendent
Tennessee School for the Deaf

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There were many contributors to this project, but special recognition is due Mr. E. Jack Goforth. It was largely his initiative and determination that focused attention on the potential of television in deaf education. Consequently, demonstrations were arranged, equipment acquired, and a systematic effort made to evaluate various aspects of television and their implications for the deaf. Numerous visits were made and publications, research findings, and other published literature were searched for additional information or data. The resulting manuscript is not intended to be comprehensive, but hopefully it will encourage further investigation and research. More important, it should answer some basic questions about television equipment and facilities for education of the deaf.

Our sincere appreciation is extended to Dr. Lloyd Graunke and the staff of The Tennessee School for the Deaf, Mr. Roy Parks and the staff of The Arkansas School for the Deaf, and other educators who have contributed to the endeavor. Special thanks are due Dr. John Gough, Director, and his staff in the Washington office of Captioned Films for the Deaf.

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William D. Jackson,
Director

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INTRODUCTION

In a silent world, the key to knowledge is the translation of visual stimuli to meaningful thought. For the deaf person the majority of meaningful experiences must be visual. Thus, various methods of visual communication are used such as speech-reading, fingerspelling, signs, gestures, and written language. Unfortunately, the visual world was not designed to translate itself into the language of the society in which the deaf person lives. Therefore, most attempts to educate a deaf person start with the process of "labeling" objects which a deaf child frequently encounters in the home and school environment, such as furniture, food, clothing, and so on. Frequency of exposure to the labeled object provides association between the object and the graphic symbols of written language.

Captioned television, if used as an environmental language tool, could increase the exposure of a deaf child to written language and the more common words used in dialogue which might lead to improved sentence structure and vocabulary, as well as reading skills.

Considerations of the role of television in deaf education usually terminate at the discussion stage. There are a number of reasons for this, but most important are the cost factor and a general lack of understanding of television's potentialities for the education of hearing-impaired students.

Although much has been written on the subject of educational television, the majority of the published material is inadequate or objectionable as far as the deaf are

concerned. Most of the literature is either so general that use of the medium as a practical tool is questionable or so technical that the non-engineering-oriented educator is lost in a sea of complicated nomenclature and specifications. It is not our purpose to make a television specialist of the deaf educator or to present the idea that television is a panacea. It is our purpose, however, to present a practical and objective viewpoint of the potential "why's" and "how's" of television programs for the hearing handicapped.

Educational television, or ETV, is the term commonly accepted to connote any video-transmitted program intended to educate, instruct, or culturally enrich viewers at home, on the job, in the classroom, or elsewhere. Educational television programs may be either open-circuit or closed-circuit transmission, depending on type of installation and other considerations related to cost, location, intended audience, legal restrictions, and technical limitations.

Television stations are classified as open-circuit and broadcast on either VHF (very high frequency) or UHF (ultra high frequency.) These stations broadcast on a prescribed frequency from a transmitter in a fixed location. Therefore any television set within range of the signal can be tuned to a given program, hence, the term "open circuit".

In contrast, closed-circuit television refers to a system in which the television receiver is linked directly to the program source either by cable or microwave. Although educational television may be either open-or closed-circuit, the typical public school or college television system is a closed-circuit television (CCTV)

installation. CCTV allows for transmission of one or more programs simultaneously over a cable or microwave network with as many channels as necessary for selective viewing by the intended audience.

Two methods of transmission may be utilized in a closed-circuit installation. These are RF (radio frequency) and video transmission. With RF, the signal is "private" and as many as twelve different programs can be transmitted simultaneously over a single coaxial cable, with receivers tunable to predesignated channels. Video transmission does not use radio frequencies. Instead, the signal is received directly by a video monitor and no provision is made for tuning. Video transmission normally produces a superior picture image; consequently it is more commonly used in situations requiring exacting definition, such as laboratory experiments and space research. However, only one program can be transmitted over a single coaxial cable. Consequently most educational CCTV installations utilize RF transmission.

Typically, effective utilization of open-circuit television in a single school building would require installation of a master antenna in order to obtain a satisfactory signal. Generally, a master antenna will provide the best image possible for a given location. Television signals are distributed through coaxial cable to classrooms and designated areas from the point of origin, in this case the master antenna. An alternate system might have the master antenna feeding into a studio so that either broadcast television or locally produced films, tapes, or live productions could be transmitted to the classroom sets.

Recent developments indicate that a closed-circuit television system using RF transmission would be desirable and practical for a campus-style or multibuilding institution, which is characteristic of most state schools for the deaf. Consideration should certainly be given to installing a master antenna system that would be connected by coaxial cable to all the buildings and dormitories. It would not only serve as a foundation for a flexible television system which could be expanded as needed at a later time, but would provide the basis for a data- porcessing computer system and eventually computer-assisted instruction, assuming such programs appear to be economically feasible and desirable.

One cannot pick up a professional journal today without encountering some reference to "new media." With media receiving such national focus, why aren't they used extensively throughout our educational system? Perhaps the answer lies in the shortage of "software," or the design and availability of materials used in conjunction with the limited equipment found in most schools. This is especially true in the area of special education and with programs for the hearing handicapped. The hardware found in most classrooms, such as projectors, recorders, and auditory training equipment, is considered to be expensive, hard to operate, and of questionable value by most teachers. Often overlooked by both teacher and administrator is the tremendous investment required to design and produce the multitude of materials or "software" for each of the different formats, such as films, filmstrips, slide, recordings, and tape. Consequently, the potential of new media for the deaf is yet to be realized although considerable effort is being made in this direction.

Television, while considered expensive by many educators, may in the long run prove to be the least expensive and most flexible and effective tool in the arsenal of new media. Suppose, for example, that a simple, relatively inexpensive captioning process were devised whereby televised programs from the educational channel could be videotaped and suitable captions added by students and teachers in the school setting. School activities also could be videotaped and captioned for use in the same manner as captioned films, but they would be on videotape. An unlimited filmtape library could then be started in every school for the deaf. These tapes could be shown in the dormitories at night or in the classroom during the day.

The equipment necessary for the above operations is now available. The cost of such an endeavor will vary considerably; however, the potential of captioned television is practically unlimited, particularly with the introduction of split screen techniques. The split-screen control mechanism is simple to operate and is relatively inexpensive. This device makes it possible to electronically "cut" a small window in one corner of the TV screen and show another picture. This electronic insert can be enlarged, vertically, horizontially,or both for a split-screen effect.

Futhermore, the TV screen can be split horizontally at the top or bottom to provide sufficient space for written or typed captions. Thus an image would appear on the TV screen with blank space for captions at the bottom or top of the screen. A vertical split-screen effect could also be achieved if fingerspelling were preferable in lieu of captions.

It is generally acknowledged that deaf students are notoriously weak in the area of news and current events. Although it would be difficult to caption a news commentary

in its entirety, it would be possible to insert key words and phrases or someone interpreting the news. Different captions or inserts could also be prepared for different language levels. Captioned 16mm sound films could be adapted for television viewing in the classroom or dormitory. Appropriate captions could be developed and inserted as desired. Thus, captioned TV programs fed into the dormitories at night could partially alleviate the lack of environmental language, and if desired, these same programs could be sent to different dormitories with different language levels simultaneously, assuming a closed-circuit cable system was installed between the different buildings. Futhermore, the same captioned material could be used in the classroom for additional reinforcement.

The shortage of qualified and capable classroom teachers is evident and the situation seems to become more critical each year. Administrators are also faced with demands for more services to more hearing-handicapped children and must compete with other programs for staff, facilities, and financial support. The impact of technology has much to offer today and promises for tomorrow. Can we afford to wait?

The various combinations of television equipment suitable for use in deaf education may be described in terms of the type of system and the level at which each is used. The systems as they are described in this paper will have some common characteristics but will also reflect some rather specific goals and objectives related to each type of equipment and suggestions for its use at different levels or stages of development in schools for the deaf. These levels and systems will be referred to in relation to the classroom and the campus of a typical school for the deaf and the implication of regional and national systems. The advantages and disadvantages of each system will be discussed in the light of technical

limitations known to exist at this time. Attention will be given to existing programs, compatibility of systems, research and development of new programs, and the means by which television can be more effectively utilized in schools for the deaf.

CHAPTER ONE

THE CLASSROOM SYSTEM

The classroom system would consist of two cameras, a videotape recorder, a special effects generator, and a monitor of sufficient size for classroom viewing.

The lower cost "home type" video recording equipment would be acceptable for use in this type of application, although the image quality would be reduced somewhat from boradcast standards. These "home type" one-half-inch tape machines generally have approximately 250 lines vertical resolution, while commercial broadcase standards approximate 400 lines. This difference is not considered a limiting factor for the purposes described here and is more than compensated for by other inherent features of current models of the various popular "home type" videotape recorders. To fully appreciate the flexibility and unique characteristics of this equipment requires only a demonstration and a few minutes to become familiar with the controls. The equipment is very simple to operate and requires only routine maintenance. Deaf children have been taught to focus the camera and operate the recorder controls, which are very similar to those of a school audiotape recorder. This type equipment was designed for use by the nontechnical person and incorporates such features as still framing, erase, and re-record as well as fast forward and reverse.

The combination of two cameras and a special effects generator with a portable videotape recorder provides additional capability and flexibility whereby captions and interpreting can be added for different reading levels commensurate with the needs of the viewing audience. In addition, several types of instructional materials can be utilized

simultaneously in a single format incorporating picture, sound, and motion, which can be stopped at will, replayed and repeated endlessly, or erased as desired and stored indefinitely in the form of a reel of one-half-inch magnetic tape. It should be noted that the ability to combine various media into one format would not only facilitate ease of operation and presentation, but would also reduce time now spent in setting up equipment and changing over from one format to another.

The potential of such a system in the classroom is tremendous and the only real limitation lies in the imagination of the user. The applications suggested below reflect only a few of the possible uses which could be made by a creative teacher. Perhaps the use of videotape would be greatest in the areas of counseling, vocational training, sports and recreation, science experiments, field trips, school events, inservice training of staff, parent orientation, and community relations.

In many vocational areas (for example, auto mechanics) problems arise that only a small number of students can work on and thus the majority receive no benefit. If these situations were videotaped, then all students in the class could benefit from problem situations where previously only a few gained anything.

In physical education and athletic programs, many problems lend themselves well to videotaping. Since the tapes can be rerun or erased and retaped as often as desired, performance deficiencies of students or athletes could be pointed out clearly and immediately, thus providing for immediate correction or improvement.

Videotape is an ideal medium for presenting verbs that are difficult for children to learn, and since the pupils themselves perform, the interest level is greatly enhanced.

The "acting out" of situations in language or social sciences stimulate livelier discussions as the pupils actually participate in the situation they view.

Primary "news sessions" are hampered because the children do not have at their command enough language to describe the ideas they want to convey. What better way to "pull" language out of children than to let them act it out so that the class can see what is happening and then work together to develop the necessary language?

One weakness of field trips is that the students often do not know what to look for an forget what they have seen by the time they return to the classroom. If these trips were on tape, then the experience could be "relived" again and again. Small details could be pointed out during repeated viewings and the development of language concepts acquired from these field trips would be immensely increased.

This system could be quite valuable during guidance sessions, either with individuals or groups. The counselor could construct any hypothetical situation that he desired to discuss and have available concrete examples to show his students.

There are some disadvantages of the classroom system,however, which should be considered. The reduced quality of the television image was mentioned earlier. While video has been used throughout the system to insure the best quality possible from the recorder, the maximum resolution is about 250 lines. This is certainly adequate for classroom instruction, but in most cases it is not the quality of a regular broadcast TV picture.

When captions are used, they must be typed or written on paper. The captioning process for the system is accomplished with two cameras and a split-screen technique. The captions are shot by one camera and inserted at the bottom of the picture received from the other camera or from another program source. (The captioning procedure used in the campus system uses a digital processor in which the captions are typed on the screen rather than on paper. Of course, the cost of such a digital system is prohibitive for classroom use.)

It should also be realized that home videotape recorders are not production machines. The lower cost one-half-inch tape equipment lacks the capability to stop and record without causing a momentary loss of sync when played back. This momentary picture distortion can be annoying to viewers if repeated stops are necessary in the recording of the program. The tape could be edited and spliced to eliminate this condition; however, repeated tape splicing is not recommended. This would not be a problem with the more expensive production type videotape recorders.

Technical Considerations

The hardware required for the classroom system would consist for the most part of components purchased from local suppliers (see Appendix A). These components are considered "off the shelf items" and represent several different manufactures. Experience with this type of equipment has been very favorable. The few differences which do exist appear to be related to personal preference of the operator and have little technical significance. More important is the reputation of the local dealer or manufacturer's

representative and the maintenance service he offers. Therefore, this discussion will be limited to the basic requirements for a system with maximum flexibility and adaptability to future developments (see Figure 1). These basic requirements are:

1. The system should have two cameras which can be driven with internal or external sync pulses. One camera should be equipped with a lens capable of focusing on a typewritten page for captioning or classroom viewing.

2. Video should be used throughout the entire system.

3. A television receiver or monitor of sufficient size for class viewing should be used (21 - 24 inch model). Television monitors should be capable of tuning all VHF and UHF stations and should be equipped with a video input and a video output. Each monitor should have a matching microphone input and audio output connection for auditory training equipment.

4. The entire system, other than classroom monitor, should be on a roll cart with all connections made permanently except for one video and audio connection and one power cord.

5. The videotape unit should be as portable as possible and should be compatable with any other television equipment used in the same system.

6. A rear screen unit should be provided for use in the recording of various projected formats such as films and slides.

7. A special effects generator should be provided with a video switcher to give the system split-screen and captioning capability.

CHAPTER TWO

THE CAMPUS SYSTEM

The campus television system in schools for the deaf should be designed to supplement classroom instruction by making taped productions available for playback on classroom recorders or by broadcasting one or more programs simultaneously to various classrooms and dormitories on the campus to be viewed at the same time or recorded for later playback. The campus system would have basically the same capabilities as the classroom system, except that it would have broadcast quality and the ability to distribute captioned or interpreted programs from all conceivable sources to any classroom, dormitory, or other specified location on the campus when requested or scheduled (see Figure 2). The campus system should incorporate a digital captioning system rather than the typed copy and camera pickup system. The design of the campus system should provide an option for the recording of assembly programs, sports activities, and other events on campus. A studio would be desirable for the production of various types of programs and to house the captioning equipment and related components.

The necessity of good broadcast quality equipment cannot be overstressed at this point. The quality of programming and captioning will depend largely upon the capability of the equipment. This should not be construed to mean that the system should approach that of a major television station. Nethertheless, inferior equipment and the limited capability of "hardware" would certainly limit the quality of "software" produced.

The advantages of a classroom television system outlined in the preceding section would apply also to a campus system. The concept of a campus system not only embraces the individual teacher and students but provides greater involvement at all levels of instruction during the school day. For example, it is often impractical to assemble the student body and instructional staff in the auditorium at one time for daily announcements and special events. Futhermore, students seated toward the rear may receive little benefit from what is happening on stage. A campus television system would make it possible for a program to be presented to the entire student body without requiring them to leave their individual classrooms. When social interaction associated with live viewing is considered necessary, it would be relatively simple to record the program and show it later in the classroom with supervision and follow-up activities. Special announcements could be presented to the entire school without assembly for that purpose in much the same way as the present intercommunication system is used, with the addition of a TV monitor showing the person or message with captions and interpreting.

Special school events, such as sports or social affairs, could be taped for later presentation to all students in dormitories or classrooms or both. These events could be captioned on different levels and presented to all students simultaneously with appropriate captions or recorded and played back in the classroom or dormitory at an appropriate time. Weekly or daily news summaries could be presented in the dormitories or classrooms to keep the children more abreast of important current events.

Captioned movies presented to large groups for entertainment often leave portions of the audience relatively "untouched." The reason generally is that most entertainment type films are captioned for relatively advanced students, and the poor readers or primary and intermediate students are left to guess at what is happening. The campus television system would enable school personnel to rewrite captions for selected films since captioned scripts are available. The regular captions could literally be stripped from the films electronically and new captions inserted for the appropriate level, resulting in a more meaningful experience for all viewers. Captioned films could also be presented in the dormitories in this matter, again eliminating the necessity for assembling students in a central auditorium. This would be especially desirable during inclement weather or with primary students whose early bedtime might prohibit the complete viewing of a feature length film.

There are other areas of great potential such as community relations and indoctrination training sessions for parents and new students. Various aspects of campus life could be presented to clear up misunderstandings, and tapes could be made to document behavior of the children or to show the educational program and facilities.

Perhaps the most important use of this system would be in the dormitories. The lack of environmental language is often cited as a major handicap to the proper language development of deaf children. Greater exposure to selected programs or films captioned for presentation in the dormitories should lead to improvement in this area and hopefully help the students to become more aware of natural language during their hours of rest and relaxation. How much more enjoyable and beneficial their favorite TV programs

would be if presented with captions and short explanations added to clarify concepts and transfer spoken information or sound effects. It would be difficult to estimate the benefit a deaf child might derive from experiences of this type or the extent to which improvement in language development would be recognized. Surely the repetion would help the younger child in his acquisition of language and understanding of his environment. Captioned TV in the dormitory is an untapped source of experience that has not been adequately researched or evaluated but could prove to be one of the most important developments in the area of deaf education.

Operation and Personnel

If plans for a campus television system are initiated and serious consideration given to developing an operational facility, it is important that the necessity for a full-time TV manager be recognized. As in most endeavors, the success of the program will reflect the interest and ability of the personnel involved and the amount of support provided by the administration. It will be difficult to find a person who is familiar with the concepts of CCTV and also experienced in either deaf education or instructional media. Certainly the value of experience in other areas should not be overlooked, but much advice will be forthcoming in the area of education and relatively little on the care and operation of the equipment. Therefore it is of prime importance that the manager be very familiar with TV equipment and procedures. Credentials are of little value if the person cannot adapt to the school environment and work effectively with students, teachers, and other staff. (See Appendix B for a more detailed description of suggested duties and responsibilities

of personnel recommended for a campus television system.)

The possibility of using student operators should not be overlooked. Most television equipment can be operated by anyone capable of operating a movie projector, and an active involvement of students would provide additional incentive to learning. In addition, such experience might lead to vocational opportunities for young adult deaf people in the electronics or television industry.

Technical Considerations

The campus system is basically a television studio connected to a closed-circuit master antenna system rather than a radiating antenna as is the case with open-circuit broadcasting, although there is some degree of similarity between the two systems. An open circuit station is primarily concerned with a single program or a single channel, whereas the studio in a campus system can originate several programs at the same time on different channels. Since the normal master system is capable of handling twelve channels, it would be possible to transmit twelve different programs at the same time, the selection of programs being made in the dormitory or classroom.

The studio design and campus facility should provide for maximum selection of programming and ease of operation. (See Appendix C for a detailed description of equipment and costs.) In addition the system should include the following features:

1. Facilities for re-transmitting programs from all channels available in the area picked up on the master antenna.

2. Facilities for showing slides and films.

3. Facilities for adaptability to studio productions.

4. Two production-type videotape recorders and facilities for recording and playing back all program inputs and outputs.

5. A digital captioning system with a data call package for storage of captions.

6. Maintenance of full audio from all inputs.

7. I. E. A. (International Engineers Association, standard) sync throughout the system.

8. A special effects generator for split-screen capability.

CHAPTER THREE

A REGIONAL SYSTEM

Although the basic facilities necessary for captioning and split-screen interpreting of local off-air TV programs and for TV viewing of captioned films in the dormitories would seem feasible in most instances, the full TV captioning facility including studio production equipment would be out of the question for most schools for the deaf at this time, particulary in states with low educational budgets. As an interim project, establishment of a Regional Captioning Center should be considered.

The Regional Captioning Center, or RCC, would need expanded production facilities in addition to those described for classroom and campus systems. The RCC would be manned by a professional staff and would resemble an average Educational TV station with the exception of the transmitting equipment (see Appendix D). The Center's prime responsibility would be to produce on videotape several hours of captioned programs from selected sources for distribution to schools for the deaf in its assigned region. For example, an RCC might caption approved TV documentaries, information programs, or common interest sports programs. Almost all TV programs contain language and/or information of educational value for the deaf. Perhaps the greatest potential of such a Center could be realized in the creation of program packages in areas previously devoid of suitable materials. Programs of interest only to the deaf could be produced and originated in the studios of the RCC, making a TV network for the hearing handicapped possible. Ideas, concepts, and news could be exchanged among teachers and students, adult deaf in the community, and parents of deaf children. The possibilities for teacher-training programming and inservice training should not be minimized or overlooked.

Another problem area in deaf education in which the RCC could provide valuable assistance is the research and design of software. With expanded production facilities, media center staff and other appropriate personnel could be utilized. Ideas and concepts could be examined, videotaped for evaluation and comment, and reproduced into permanent formats such as slides, filmstrips, or 8mm cartridges.

Technical Considerations

First, let us examine how such a system might function (see Figure 2 and Appendix C). The RCC would produce captioned videotapes and mail them to one or more schools. The schools in turn would play the tapes on their respective systems, copy or dub them if desired, and then mail the tapes to another school to start the process all over again. After the appointed rounds, the tapes would be returned to the RCC for retapeing or storage.

Tape compatability is mandatory if such a system is to function properly. The RCC would need video recorders like those used by the schools, or a standard would have to be extablished so that all schools would have the same type of recorders. In order to hold the cost of both equipment and personnel to a practical level and still maintain acceptable video quality, one-inch industrial videotape recorders are suggested. While these recorders are more expensive than home type machines, they have greatly improved video quality. (The video quality is still inferior to broadcast standard transverse machines, but the initial cost of transverse equipment and the necessity of a technician to operate and maintain it make this type recorder unrealistic at this time).

Cost Estimates for School System Designed for RCC Tapes

The equipment cost for the school would depend on method of distribution of the taped information. If the school used one tape machine and one monitor at point X in the school, the cost would be approximately $4,500. If the school already had a master antenna system installed, the cost would be approximately the same. (The cost of equipment and monthly operation cost of a tri-channel system is shown in Appendix E).

NATIONAL SYSTEM OF CAPTIONED TELEVISION

Since captioned television would be annoying to the majority of hearing viewers, commercial television stations would be reluctant to caption even a small percentage of their programs. Therefore, if captions useful to the deaf are to be put on open-circuit television, a method of transmission acceptable to the station and the hearing viewer must be devised. Such a system is now available. Its principle is quite simple, and the techniques are those used in other areas of electronics and broadcasting. The system could be designed so that no modification to the television stations' equipment would be necessary. Following is a brief description of such a system and how it might function:

Let us assume that the decision has been made to caption a film or taped program. The caption writer would view the films or tape prior to presentation on the air to prepare digital captions. Captions would be written on a typewriter type keyboard that writes electronically in digital bits which are recorded on magnetic audiotape or fed directly to

caption-inserting circuits on the television screen. The caption writer would use the audio track of the tape or film much in the same manner as a secretary uses dictation and recording discs, condensing some areas of dialogue and expanding others. The key to the system is that the captions are stored on audiotape as digital impulses, similar to an audio note in music. After the caption tape has been prepared, the caption operator must synchronize the tape to the program material. To place the captions on the screen, the digital impulses must be transmitted to the home receiver which is fitted with the caption-producing circuit. Two methods could be used to accomplish this. One method involves the use of an FM station having an area coverage similar to that of the television station. To multiplex the digital impulses on a subcarrier which would not be heard in the regular programs. (Multiplexing, a method of carrying up to three programs on the same station simultaneously, is in use today by many FM stations). The other method requires the television station to multiplex the digital impulses into its sound carrier, since the sound in television is transmitted by FM. However, the Federal Communications Commission has denied television stations the right to multiplex their sound carriers; therefore a change in law as well as modification of the television transmitter would be necessary if the latter system were to be used.

Home television receivers can be modified to accept information from both the television station and captioning circuits. The captioning impulses are received from the FM or TV station multiplex signal. The information is detected and fed to the caption producting circuits, resulting in captioned television.

This is somewhat of an oversimplification; however, the necessary equipment for production of captions as described above is now available commercially. The Visual Electronics Corporation, for instance, can supply all components necessary for producing digital caption tapes and decoding them into usable captions on home television receivers. An important aspect of this approach to captioning is that once a digital caption tape is cut, the caption tape can be sent with a film, videotape, or program script to any other location and used over and over again. This means that the time and effort required to caption a program need be expended only once.

Perhaps the biggest bug in the system will be in preparation of the captions. It would be difficult for a person to caption fast enough to keep up with live, off-the-air productions. The time necessary to prepare a series of captions would probably run to-one; - in other words, approximately one hour would be required to prepare captions for a half-hour show. Certainly, the quality of the caption content would be proportional to the time spent in its development.

It is believed such a system would be very beneficial to the education and entertainment of both students in schools for the deaf and the adult deaf, even if only a few hours a day were available. Through cooperation with individual stations and networds, such a program could be undertaken at nominal cost.

Technical Considerations

The cost and installation of equipment necessary for captioning any type of television program would probably be less than $10,000, including keyboard, monitor,

caption data production unit, and storage (tape) equipment. This does not include the cost of production, which can be broken down into two main areas - personnel and services. Since only one person is needed to operate the captioning equipment, his salary would be the only personnel cost (assuming that captions were to be produced no more than four hours a day). It should be recognized that one FM station could carry two digitally captioned programs at the same time, thus serving as the caption transmitter for two different stations simultaneously. This could become important when considering coverage and cost of FM stations to carry the digital information necessary for captioning.

The cost of the multiplex channel from a FM station will vary according to station and its location, ranging from a few dollars to more than one hundred dollars per day when bought on an annual basis. A telephone line from the television station to the FM station would be nominal in cost when purchased on a yearly basis, possibly not more than twenty-five dollars per month. The television station would probably require a small fee to house the captioning equipment and provide it with a video feed.

If an educational station were available, however, the cost might be minimal. Agreement for the maintenance of equipment could be considered as part of the negotiation and a fixed price agreed upon to cover housing, maintenance, telepone line, and so on. Since the captioning equipment used is purely electronic, no supplies other than an occasional spare part would be required.

The receiving equipment in the home would cost considerably more than an ordinary black-and-white receiver. At this time a receiving setup as described in this

paper is not sold commercially. The system is similar to a component hi-fi system, however, as the captioning decoder, FM receiver, and television could be very easily mated into one system. The cost of the system without mass production of these "special sets" as a complete unit would probably be less than $2,000. Mass production should bring the price down considerably, as would the availability of matched components which could be purchased individually and assembled as a package.

SUMMARY

From this vantage point, it would appear that the use of television as an environmental language tool would be very beneficial to the deaf. More effective use of television in schools for the deaf should make available new techniques and materials never considered possible a few years ago. It could give flexibility to the Captioned Films program and result in widespread usage of instructional media at every level of instruction. It could turn the idle recreation time into meaningful experiences, create a learning environment in the living quarters of the school, and extend the curriculum to areas outside the classroom. The hearing-handicapped can be served well by television and creativity. The concepts discussed in these pages are not idealistic. Hardware is available. With adequate financial support and imaginative leadership, such programs could become a reality.

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APPENDICES

Appendix A

ESTIMATED EQUIPMENT COSTS FOR A CLASSROOM SYSTEM

VTR unit	Concord VTR 600 - 1	$ 1,150.00
Monitors	Two 9 inch, Condord MR - 600	320.00
Special effects & switches	Concord	650.00
Cameras	Two MTC 18 with normal lens	850.00
Roll cart		30.00
1 roll of tape	Concord VT1-40 minute	42.50
Copy stand		20.00
Miscellaneous cables & hardware		25.00
Total cost		$ 3,087.50

Note: Classroom monitor was not included in this system. Monitor described in the classroom system is the Setchell - Carlson model 2100 - 50, with video driver added. Cost $264.50

Appendix B

ESTIMATED STAFF REQUIREMENTS FOR A CAMPUS TELEVISION SYSTEM

Single Channel Captioning System:

1. Manager (full time) Duties would be taping and caption writing.

2. Operator (part time) Duties would be taping and playing back at appropriate time. This could be a student or nonskilled person.

Split-Screen Captioning System - Single Channel:

1. Manager (full time) Should be curriculum oriented.

2. Operator (full time) Should be equipment and production oriented.

3. Interpreter (part time) Should be able to assist manager and to caption.

4. Operator (part time) Could be student or nonskilled person.

System with Filmslide Chain Added:

Same as above, but using a full-time interpreter.

System with Live Capability:

1. Manager (full time) Role changes to coordinator and production supervision.

2. Video-Audio Operator (full time) Handles operation and technical problems.

3. Caption Operator (full time) Deaf educator working completely with caption dialogue.

4. Production Director (full time) With art background and TV production experience.

5. Camera Operators (part time) Students.

6. Assistant Control Room Operators (part time) Students.

7. Interpreter (full time) Should be able to assist with art, sets, and operation.

The above is based on an eight-hour working day, which would produce four hours per day of captioned video. The quality level of live production should be very acceptable within these guidelines; however, the quality should not be compared with network production in which hundreds of professionals and millions of dollars worth of equipment are used. Locating qualified personnel is a serious problem. Therefore, from a practical standpoint it might become necessary to employ more than three full-time people in the initial stage of development. Gradually, the staff would become more adept and experienced, consequently part-time staff with less experience could be utilized.

Appendix C

SUGGESTED EQUIPMENT AND ESTIMATED COSTS FOR A CAMPUS TELEVISION

System 1: Single Channel Off-air Captioning System

1. Conrac Off-air receiver - ERL 82A/R, 1 each	$ 275
2. Digital captioning unit w/tape reader, 1 each	10,000
3. Video tape recorders - IVC 800 (color), 2 each	8,400
4. Twin 9 inch video monitors - Conrac RNC9/29, 1 each	845
5. Mich cable and simple switcher	100
6. RF modulator - Jerrold model TD, 2 each	1,652
7. Waveform monitor - Ratheon 104121-02, 1 each	1,275
Total	$ 22,547

System 2: Split-Screen Interpreting with Off-air Pickup (Addition to System 1)

1. EIA Sync Generator - Ratheon 10158501, 1 each	1,495
2. Video switcher w/preview - Buss-Raytheon, 1 each	1,365
3. Special effects generator - Ball Mark VI, 1 each	1,500
4. Twin 9 inch video monitors - Conrac RNC9/29, 1 each	845
5. Camera control unit - Raytheon 101518, 1 each	1,200
6. Camera unit and tripod - Raytheon viewer, 1 each	5,100
7. Lens & cable for camera - Mich zoom	800
8. Circuit breaker panel - Raytheon 101524, 1 each	72
9. Console inclosures - Raytheon 230274, 2 each	320
Total	$ 12,697

System 3: Film, Filmstrip, and Slide Projection - Captioning and Split-Screen Interpreting

(Addition to Systems 1 and 2)

1. 4 input Prism multiplexer - Raytheon 101520-01, 1 each	1,680
2. Film camera head - Raytheon FC-11, 1 each	2,175
3. Camera control unit - Raytheon 101518, 1 each	1,200
4. Console inclosure - Raytheon 230274, 1 each	160
5. Circuit breaker panel - Raytheon 101524, 1 each	72
6. Lens kit for multiplexer - Raytheon 101520, 1 each	401
7. Carousel slide projector & mounting kit, 1 each	378
8. 16mm television projector, 1 each	800
9. Remote control unit for multiplexer & projector, 1 each	360
10. 17" video monitor in metal cabinet - Conrac, 1 each	350
11. RF modulator unit - Jerrold model T.D., 1 each	826
Total	$ 8,402

Appendix C (con't)

System 4: Studio Production Capability with Audio Switching and Pickup (Addition to Systems 1, 2, and 3)

1. Camera unit - Raytheon 100520-04, vidicon viewfinder	4,200
2. Camera control unit - Raytheon 101518, 1 each	1,200
3. Circuit breaker panel - Raytheon 101524, 1 each	72
4. Twin 9" video monitors - Conrac RNC9/29, 1 each	845
5. Console inclosure - Raytheon 230274, 1each	160
6. Tripod & dolly for 2 cameras	800
7. Audio console and 2 miles, RCA	700
8. Lens and camera cable	800
9. RF modulator - Jerrold model T.C.	826
10. Minimum mich lighting (portable & controls)	500

Total Cost for all Systems $53,749.00

Appendix C (con't)

Projected Cost for Installation and Operation of Average School Captioning System

Initial equipment cost (including installation)	45,000
Yearly depreciation and upkeep (approximately 10 per cent of cost)	4,500
Videotape - approximately 50 rolls/year (unit cost - $60/roll)	3,000
Television manager (full time) dependent on credentials, yearly	8,000
Video operators - usually unskilled or semi-skilled (full time, yearly)*	4,000
Totals - less initial equipment cost per year	19,500

* It is assumed that a school would use student labor when practical and have sufficient staff to cover interpreting duties.

Note: Visual Electronics Corporation of New York, which is the only present manufacturer of digital captioning equipment, will lease-purchase their captioning device for approximately $400 per month.

Appendix D

STAFF REQUIREMENTS AND OPERATING COSTS FOR A REGIONAL CAPTIONING SYSTEM

1. Manager or Director - coordinator of all departments and schedule programming.
2. Chief Engineer or Technician - maintenance and supervision of technical operation.
3. Production Director - direction of programs, supervision of sets, design and studio props.
4. Artist/Photographer - production of slides, artwork, sets, lighting.
5. Floor Manager & Operator - assists in sets and operation of cameras
6. Operator - video and tape - semi-skilled technician.
7. Operator - audio and tape - semi-skilled technician.
8. Caption Operator - deaf educator
9. Interpreter/Copy Writer - deaf educator
10. Secretary

Approximate yearly salaries	$ 60,000
Studio space - rent	10,000
Art and set supplies	5,000
Equipment depreciation and maintenance cost	7,000
Videotape cost per year - approximately 200 rolls	12,000
Mailing cost (tapes) estimate $12/day - 260 days/year	10,000
Total operation cost per year	$ 107,120

Note: This estimate does not include staff for curriculum development. Above staff should be capable of mailing four four-hour sets of programming per day. Budget increase of 20 per cent for additional staff and equipment would probably double the output of caption programs.

Appendix E

COST ESTIMATES FOR A SCHOOL TELEVISION SYSTEM USING ONLY MATERIAL PROVIDED BY A REGIONAL CAPTIONING CENTER

Initial Cost for Equipment:

3 industrial videotape recorders @ $4,200	$12,600
3 RF modulators @ $826	2,478
Simple switcher system @ $25	25
Total	$15,103

Note: The total shown is less master antenna equipment and TV monitors. Because of the different requirements and school configurations, master antenna systems are almost impossible to cost estimate without individual consideration.

YEARLY OPERATING EXPENSE

Depreciation and upkeep (10 per cent)	1,510
Personnel - (one part time)	2,000
Mailing expense - approximately $2 per day	750
	$ 4,260
Initial equipment cost (less antenna system)	
Total expense	15,103

Figure #1. Suggested Equipment Layout for a Classroom System

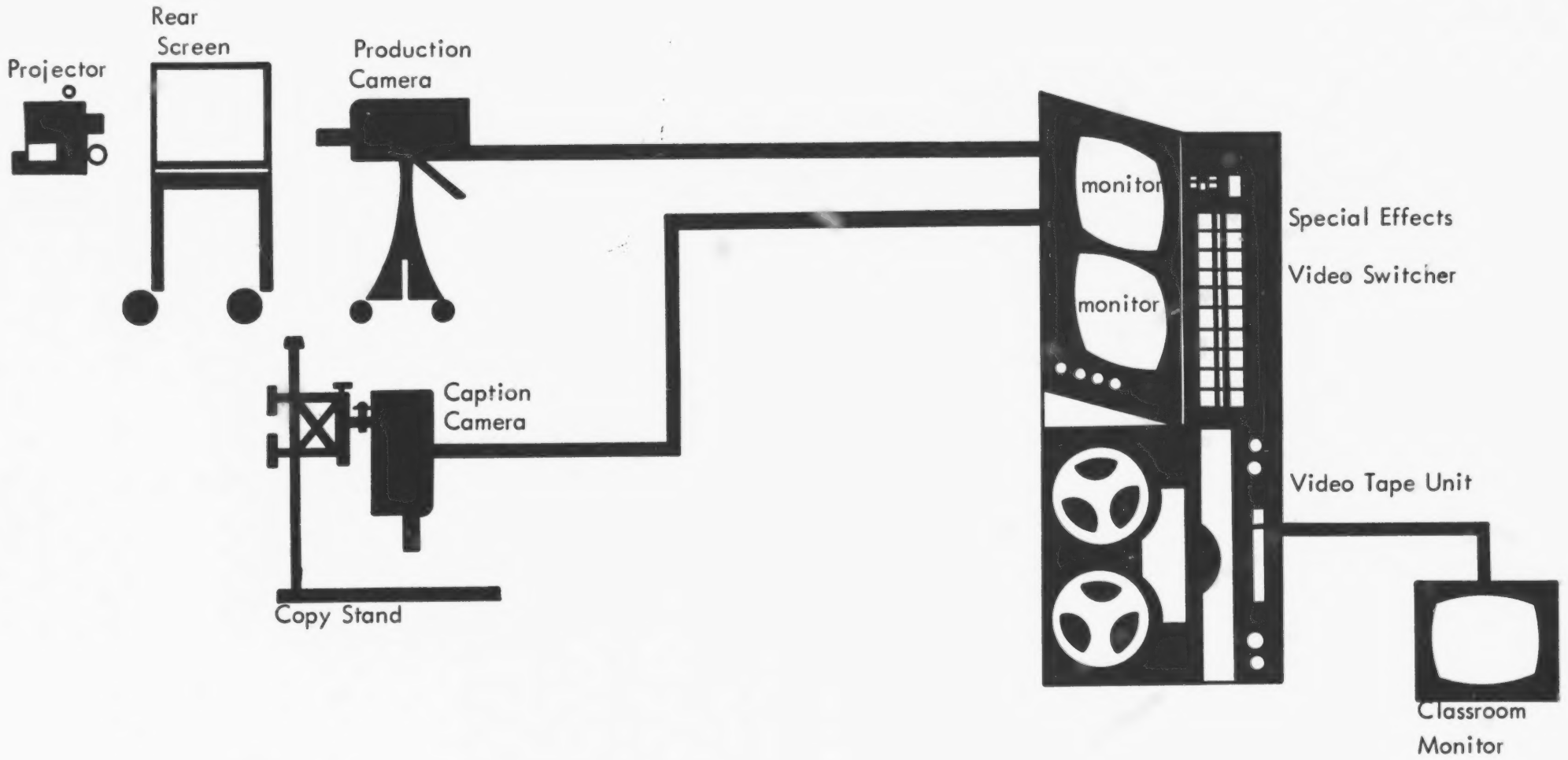

Figure #2. Suggested Equipment Layout for a Campus System

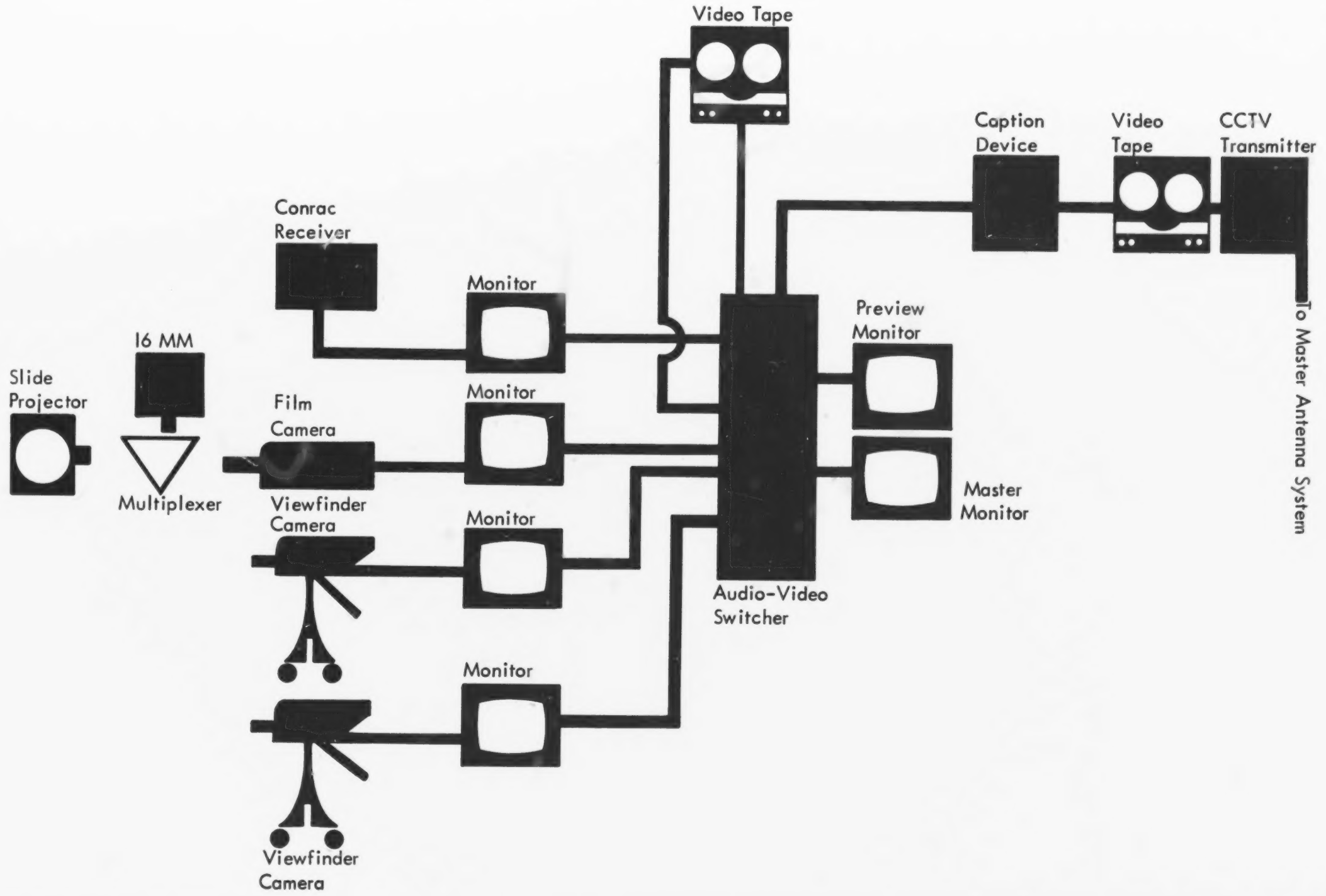

Figure # 3. Suggested Equipment Layout for a Regional Captioning Center